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Value Engineering and Its Impact on Construction Projects Using Building Information Modeling

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Abstract

Due to the fact that science is advancing and construction in our society is increasing, the engineering community is also obliged to introduce new approaches to the country and use them in this field. The traditional method (CAD) used to be used in this field and now the engineering community in most of the world uses Building Information Modeling (BIM) technology. BIM helps the project team observe what will be built in a simulated environment. This study examines the role of BIM in reducing time, cost savings, quality improvement, monitoring, control, estimating time and cost, comparing current conditions with standards, and reporting. We also compared the two projects, one using BIM and the other using the traditional method. The results showed that the use of BIM helps to include value engineering in projects, collisions do not occur during project implementation.

Keywords: Building information modeling, Reconstruction, Value engineering, Traditional method.

1 | Introduction

Today, the presentation of a three-dimensional model of real-world complications is very important and widely used, and has attracted the attention of researchers in various fields, including mapping and spatial information systems, and those interested in three-dimensional reconstruction of buildings [1]. Building is the key part of information in a three-dimensional city model, so extracting and modeling buildings from remote sensing data is an important step in building a digital model of a city. In this research, a new perspective for building reconstruction is introduced. This method is used using Building Information Modeling (BIM) [2] and [3].

Zhou et al. [4] conducted research on BIM implementation strategies. In order to implement BIM in an organization, they say, technical issues must be considered in that organization. Technical issues include the software and hardware required to run. In relation to software, we must have a list of software packages available for BIM and know which ones are available to us if needed so that we can select the required software according to the conditions in the organization. In terms of

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hardware, systems in the organization should be examined so that BIM software can be easily installed and work on them, so we must be aware of the hardware requirements of the software. Research conducted by Ahmad et al. [5] has concluded that BIM eliminates the majority of significant risks in construction. In a case study, it was found that with limited experience and knowledge to provide a model for asset management, the project team often "led to a problem through a mistake." This was not necessarily due to a lack of training, but a lack of BIM knowledge, which instinctively affected daily performance [6]. Today, BIM is used in the manufacturing process as a common design software. This standard is widely used, although the use of BIM is not a consistent cycle design and its use and output results depend on the environment and conditions.

2 | Methodology

The Likert scale is one of the most common measurement scales in research that is based on a questionnaire and was invented by Rennes Likert. In this scale or spectrum, the researcher, according to the subject of his / her research, provides a number of items to the participants to determine their tendency based on multiple items and answers. The Likert scale is one of the most common measurement scales in research based on a questionnaire.

The answers are multiple choice, for example in the 1-point mode the options include "very low, low, medium, high and very high". Questionnaires based on the Likert scale usually use the five-state mode, but many psychometers also use the seven-nine mode. (Design and construction of a scale of total Likert scores with a research approach in management). In this questionnaire, its five systems have been used to increase the accuracy of measurement.

Table 1. Questionnaire scaling table.

Qualitative definition of the impact of factors	Impact rate
Very little: It has not affected.	1
Low: Has a small and negligible effect.	2
Medium: Affected.	3
High: Has had a significant impact.	4
Too much: has had the highest impact.	5

2.2 | Evaluation of Research Reliability

Demonstrates the reliability, stability, and consistency of the concept being evaluated by the research and helps to evaluate the correctness, goodness, or value of a measure. The ability of a measure to maintain stability over time is an indicator of stability and its low vulnerability to change. Internal consistency of metrics is an indicator of homogeneity in metrics that reflects a concept. In this research, the internal adaptation method has been used to evaluate the questions related to each part of the research questionnaire. Cronbach's alpha is the most widely used method for ranking scales. In this method, if Cronbach's alpha is higher than 0.7, the questionnaire has the necessary reliability. To calculate the Cronbach's alpha coefficient, we first calculate the variance of the scores of each questionnaire and the total variance, the formula of which is [7]:

$$v_a = \frac{J}{j-i}\left(1 - \frac{\sum si^2}{s_t^2}\right). \quad (1)$$

v_a: Number of questionnaires or test subsets.

si^2: The variance of question i of the questionnaire or test.

s_t^2: The total variance of the questionnaire or test.

The following is the Cronbach's alpha calculated by SPSS software in *Table 2*, which shows the reliability of the research.

Table 2. Calculation of Cronbach's alpha of the questionnaire.

Cronbach's alpha coefficients	Variables
0.91	Part One (Questions 1 to 10)
0.827	Part II (Questions 11 to 14)
0.73	Part Three (Questions 15 to 18)
0.825	Section 4 (Questions 19 to 23)
0.865	Section 5 (Questions 24 to 31)
0.892	The whole questionnaire

In this type of analysis, the researcher summarizes and classifies the collected data using descriptive statistical indicators. At the descriptive level, frequency indicators (frequency, frequency percentage, etc.) have been used. In this section, statistical tables related to the questionnaire questions are examined.

Table 3. Study of the frequency distribution of gender variables.

Frequency	Abundance	Gender
65.71	23	Sir
34.29	12	Lady

As you can see in the table above, 23 of the respondents are men and 12 are women.

Table 4. Study of the frequency distribution of the variable of education.

Frequency	Abundance	education
42.85	15	Bs.
51.42	18	Ms
5.73	2	P.H. D

Table 5. Examining the frequency of the field of study variable.

		Frequency	Percent	Valid Percent	Cumulative Percent
Construction	Construction	19	54.3	54.3	54.3
Architecture	Architecture	12	34.3	34.3	88.6
Facilities	Facilities	4	11.4	11.4	100.0
Total	Total	35	100.0	100.0	

As you can see in the *Table 5*, diagram and figure above, 19 of the respondents have studied civil engineering, 12 have studied architecture and 4 have studied in the field of facilities.

Table 6. Examining the frequency of work experience variable.

	Work experience			
	Frequency	Percent	Valid Percent	Cumulative Percent
Under 5 years	6	17.1	17.1	17.1
5 to 10 years	16	45.7	45.7	62.9
10 to 15 years	13	37.1	37.1	100.0
Total	35	100.0	100.0	

As you can see in the *Table 6*, the respondents of the questionnaire have 6 to 5 years of work experience, 16 people have 5 to 10 years of work experience and 13 people have 10 to 15 years of work experience.

Table 7. Examining the frequency of the variable of familiarity with BIM.

How familiar are you with building information modeling?	Frequency	Percent	Valid Percent	Cumulative Percent
I'm somewhat familiar	26	74.3	74.3	74.3
I have the necessary familiarity and knowledge	9	25.7	25.7	100.0
Total	35	100.0	100.0	

As you can see in the *Table 7*, 26 respondents are somewhat familiar with BIM and 9 are well acquainted

Table 8. Examining the variables of barriers to using building information modeling.

Barriers to using and learning building information modeling	Frequency	Percent	Valid Percent	Cumulative Percent
Current technology is not enough	29	82.9	82.9	82.9
The cost of training and copyright is high	5	14.3	14.3	97.1
People do not want to learn	1	2.9	2.9	100.0
Total	35	100.0	100.0	

As you can see in *Table 8*, 29 people have not responded to the current technology, 5 people have responded to the high cost of training and copyright, and 1 person to those who do not want to learn has answered.

Table 9. Study of the variables of the best advantage of building information modeling.

The best advantage of building information modeling	Frequency	Percent	Valid Percent	Cumulative Percent
Quality Improvement	6	17.1	17.1	17.1
Reduce costs	8	22.9	22.9	40.0
Reduce time	6	17.1	17.1	57.1
Durability	2	5.7	5.7	62.9
Creativity	8	22.9	22.9	85.7
Reduction of human resources	5	14.3	14.3	100.0
Total	35	100.0	100.0	

As you can see in *Table 9*, 6 responded to the quality of the upgrade, 8 to the cost reduction, 6 to the reduction in time, 2 to the sustainability, 8 to the creativity, and 5 to the reduction in human resources.

Table 10. Examining the variables of the fields of using building information modeling.

Areas of use of building information modeling	Frequency	Percent	Valid Percent	Cumulative Percent
3D illustration	14	40.0	40.0	40.0
Find the collision	14	40.0	40.0	80.0
Structural energy analysis	7	20.0	20.0	100.0
Total	35	100.0	100.0	

As you can see in *Table 10*, 14 responded to 3D imaging, 14 to collision detection, and 7 to energy structure analysis.

Table 11. Examining the variables of the fields of using building information modeling in the future.

Will you use building information modeling in the future?				
	Frequency	Percent	Valid Percent	Cumulative Percent
Definitely yes	7	20.0	20.0	20.0
Probably yes	22	62.9	62.9	82.9
I do not know	6	17.1	17.1	100.0
Total	35	100.0	100.0	

As you can see in *Table 10*, 7 people said they would definitely use BIM in the future, 22 people said they would probably use BIM, and 6 people said they did not know how to use BIM. Do or not.

3 | Concloutions

Renovation of a building often involves changing the interior decoration, renovating the building, etc. Sometimes the structure is very old and the useful life of the building has expired and it has been destroyed and rebuilt. In this study, the use of BIM approach and its benefits in building reconstruction were investigated. Using the questionnaire method and the guidance of the tutor and consultant, questions were asked and provided to the experts of this technology. We also compared two projects that used BIM in one and the traditional method in the other. It can be concluded from the survey that BIM reduces cost time and increases quality by designing high quality, integrated information and detailing components and smartening, reducing rework volume and predicting errors (value engineering is considered). Eighty-three percent of those who said that current technology was not enough to learn and learn BIM. Also, companies are not very willing to use BIM due to lack of knowledge about BIM because it is a waste of time and money and human resources, but research shows that reducing costs and time are among the benefits of using Is from BIM. It should also be noted that BIM is not just for construction and reconstruction, but for the entire project yard cycle. Given that 20% of people said they would definitely use BIM and 62% said they would probably use BIM in the future, it shows that with a little effort and learning and training BIM can be done. Widely used in society. It should be noted, however, that people who say they use BIM have different definitions of BIM, although BIM is well defined in international standards.

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